

CLAIMS

We claim:

[cl001] 1. A component for use in a bearing unit, the articulation surface comprising:

 a load bearing and articulation portion,
 a volume of superhard material located on said load bearing and articulation portion, and
 a superhard articulation surface formed by at least a portion of said volume of superhard material, said articulation surface being formed to permit low-friction articulation in a bearing unit, and said superhard articulation surface forming at least a portion of said load bearing and articulation surface portion.

[cl002] 2. A component as recited in claim 1 wherein said superhard material is selected from the group consisting of diamond, cubic boron nitride and wurzitic boron nitride.

[cl003] 3. A component as recited in claim 1 wherein said superhard material has a Knoop hardness of at least about 4000.

[cl004] 4. A component as recited in claim 1 further comprising a counter bearing surface for articulation against said superhard articulation surface, said counter bearing surface including diamond.

[cl005] 5. A component as recited in claim 1 further comprising a counter bearing surface for articulation against said superhard articulation surface, said counter bearing surface including a material other than diamond.

[cl006] 6. A component as recited in claim 1 including a continuous phase of polycrystalline diamond.

[cl007] 7. A component as recited in claim 6 wherein said continuous phase of polycrystalline diamond includes solvent-catalyst metal and carbon, and

said continuous phase of polycrystalline diamond includes bonds between said solvent-catalyst metal and said carbon.

[cl008] 8. A component as recited in claim 1 wherein said superhard articulation surface accommodates sliding articulation against an opposing surface.

[cl009] 9. A component as recited in claim 1 wherein said superhard articulation surface accommodates rolling articulation against an opposing surface.

[cl010] 10. A bearing unit as recited in claim 6 wherein said continuous phase of polycrystalline diamond has a residual stress field that tends to improve strength of the bearing unit.

[cl011] 11. A component for a bearing unit comprising:
a quantity of polycrystalline diamond,
carbon bonds within said polycrystalline diamond,
a crystalline structure within said polycrystalline diamond, and
a low-friction articulation surface formed at least in part by a quantity of said polycrystalline diamond.

[cl012] 12. A component as recited in claim 11 including a continuous phase of polycrystalline diamond.

[cl013] 13. A component as recited in claim 11 wherein said articulation surface includes a flat portion.

[cl014] 14. A component as recited in claim 11 wherein said articulation surface includes a curvilinear portion.

[cl015] 15. A component as recited in claim 11 wherein said low-friction articulation surface accommodates rolling articulation against an opposing surface.

[cl016] 16. A component as recited in claim 11 wherein said low-friction articulation surface accommodates rolling articulation against an opposing surface.

[cl017] 17. A bearing unit as recited in claim 12 wherein said continuous phase of polycrystalline diamond has a coefficient of thermal expansion CTE_{Cd} , wherein said substrate has a coefficient of thermal expansion CTE_{sub} , and wherein CTE_{Cd} is not equal to CTE_{sub} .

[cl018] 18. A bearing unit as recited in claim 12 wherein said continuous phase of polycrystalline diamond is sintered polycrystalline diamond and has a residual stress field that tends to improve strength of the bearing unit.

[cl019] 19. A bearing assembly comprising:
a bearing having an articulation surface,
a race having an articulation surface,
wherein at least one of said articulation surfaces is non-planar,
at least one of said bearing and said race including a substrate,
a quantity of diamond located on said substrate, said diamond forming at least a portion of one of said articulation surfaces.

[cl020] 20. An assembly as recited in claim 19 wherein said diamond is located in a segmented polycrystalline diamond compact.

[cl021] 21. An assembly as recited in claim 20 wherein said segmented polycrystalline diamond compact has a shape selected from the group consisting of round and tetragonal.

[cl022] 22. An assembly as recited in claim 19 wherein said diamond is a continuous phase of polycrystalline diamond.

[cl023] 23. An assembly as recited in claim 19 wherein articulation surfaces of both said bearing and said race include diamond.

[cl024] 24. An assembly as recited in claim 19 wherein an articulation surface of at least one of said bearing and said race include a material other than diamond.

[cl025] 25. An assembly as recited in claim 20 wherein said segments are nested inlays.

[cl026] 26. An assembly as recited in claim 19 wherein said diamond is present in a pattern selected from the group consisting of strips, spirals and patches.

[cl027] 27. An assembly as recited in claim 19 wherein said diamond is present in the form of plugs in receptacles on said substrate.

[cl028] 28. An assembly as recited in claim 19 wherein said diamond is formed by a process selected from the group consisting of chemical vapor deposition, physical vapor deposition and sintering.

[cl029] 29. An assembly as recited in claim 19 further comprising veins of a metal located between portions of diamond.

[cl030] 30. An assembly as recited in claim 19 wherein said articulation surfaces accommodates sliding between each other.

[cl031] 31. An assembly as recited in claim 19 wherein said articulation surfaces accommodates rolling between each other.

[cl032] 32. An assembly as recited in claim 22 wherein said continuous phase of polycrystalline diamond has a coefficient of thermal expansion CTE_{Cd} , wherein said substrate has a coefficient of thermal expansion CTE_{sub} , and wherein CTE_{Cd} is not equal to CTE_{sub} .

[cl033] 33. An assembly as recited in claim 22 wherein said continuous phase of polycrystalline diamond has a residual stress field that tends to improve strength of the bearing unit.

[cl034] 34. A bearing unit comprising:

- a bearing unit polycrystalline diamond compact,
- a substrate that is part of said bearing unit polycrystalline diamond compact, said substrate including a metal,
- a bearing unit diamond table sintered to said bearing unit substrate,
- a zone between said bearing unit substrate and said bearing unit diamond table, said zone exhibiting a gradient of solvent-catalyst metal to diamond content, said gradient being selected from the group consisting of interface gradient, continuous gradient and incremental gradient, said zone being referred to as a gradient transition zone,
- chemical bonds located in said compact which tend to secure said diamond table to said substrate, said chemical bonds including diamond-to-diamond bonds, diamond-to-metal bonds, and metal-to-metal bonds,
- a mechanical grip between said bearing unit diamond table and said bearing unit substrate which tends to secure said diamond table to said substrate, said mechanical grip being created at least in part by dilatation of said substrate,
- interstitial spaces in said bearing unit diamond table,
- substrate metal located in said bearing unit diamond table interstitial spaces,
- a residual stress field in said bearing unit polycrystalline diamond compact that tends to enhance the strength of said bearing unit polycrystalline diamond compact, and
- a bearing unit load bearing and articulation surface on said polycrystalline diamond compact, said bearing unit load bearing and articulation surface including polycrystalline diamond, wherein said bearing unit load bearing and articulation surface is non-planar.

[cl035] 35. A bearing unit as recited in claim 34 wherein sintered diamond in said bearing unit polycrystalline diamond compact has a coefficient of thermal expansion CTE_{Cd} , and wherein said substrate in said bearing unit polycrystalline diamond compact has a coefficient of thermal expansion CTE_{sub} ,

and wherein CTE_{Cd} is not equal to CTE_{sub} , wherein said diamond in said bearing unit polycrystalline diamond compact has a modulus M_{Cd} , and wherein said substrate in said bearing unit polycrystalline diamond compact has a modulus M_{sub} , and wherein M_{Cd} is not equal to M_{sub} .

[cl036] 36. A bearing unit as recited in claim 34 wherein said bearing unit polycrystalline diamond compact is polished to an Ra value of between about 0.3 to about 0.005 microns.

[cl037] 37. A bearing unit as recited in claim 34 wherein said bearing unit load bearing and articulation surface accommodates sliding articulation against an opposing surface.

[cl038] 38. A bearing unit as recited in claim 34 wherein said bearing unit load bearing and articulation surface accommodates rolling articulation against an opposing surface.

[cl039] 39. A component for use in a bearing unit, the component comprising:

- a sintered polycrystalline diamond compact,
- a substrate located on said polycrystalline diamond compact,
- substrate surface topographical features located on said substrate, said substrate surface topographical features tending to increase surface area of contact between said substrate and a diamond table,
- a diamond table sintered to said substrate on said polycrystalline diamond compact,
- a gradient transition zone between said substrate and said diamond table, chemical bonds between said diamond table and said substrate which tend to secure said diamond table to said substrate, and
- a load bearing and articulation surface on said polycrystalline diamond compact, said load bearing and articulation surface including polycrystalline diamond, said load bearing and articulation surface being non-planar and formed to present a surface that accommodates bearing unit articulation.

[cl040] 40. A bearing unit component as recited in claim 39 wherein diamond in said polycrystalline diamond compact has a coefficient of thermal expansion CTE_{Cd} , and wherein said substrate in said polycrystalline diamond compact has a coefficient of thermal expansion CTE_{sub} , and wherein CTE_{Cd} is not equal to CTE_{sub} .

[cl041] 41. A bearing unit component as recited in claim 39 wherein said diamond in said polycrystalline diamond compact has a modulus M_{Cd} , and wherein said substrate in said polycrystalline diamond compact has a modulus M_{sub} , and wherein M_{Cd} is not equal to M_{sub} .

[cl042] 42. A bearing unit component as recited in claim 39 further comprising a mechanical grip between said diamond table and said substrate, said mechanical grip tending to secure said diamond table to said substrate, and said mechanical grip being present where substrate surface topographical features contact diamond.

[cl043] 43. A bearing unit component as recited in claim 39 further comprising a residual stress field in said polycrystalline diamond compact that tends to enhance the strength of said polycrystalline diamond compact, characteristics of said residual stress field being determined at least in part by the nature of said substrate surface topographical features.

[cl044] 44. A bearing unit component as recited in claim 39 wherein said substrate has a general surface shape; and wherein at least some of said substrate surface topographical features protrude away from said substrate general surface shape.

[cl045] 45. A bearing unit component as recited in claim 39 wherein said substrate has a general surface shape, and wherein at least some of said substrate surface topographical features are formed by substrate material that does not extend completely to said substrate general surface shape.

[cl046] 46. A bearing unit component as recited in claim 39 wherein said load bearing and articulation surface accommodates sliding articulation against an opposing surface.

[cl047] 47. A bearing unit component as recited in claim 39 wherein said load bearing and articulation surface accommodates rolling articulation against an opposing surface.

[cl048] 48. A bearing unit component as recited in claim 45 wherein said substrate surface topographical features tend to distribute said stress field over a larger surface area than if said substrate surface topographical features were absent.

[cl049] 49. A bearing unit component as recited in claim 45 wherein said substrate surface topographical features tend to limit peak stress in said polycrystalline diamond compact.

[cl050] 50. A bearing unit component as recited in claim 45 wherein said substrate surface topographical features serve at least in part to increase the depth of said gradient transition zone compared to the depth said gradient transition zone would have absent said substrate surface topographical features.

[cl051] 51. A bearing unit component as recited in claim 48 wherein said substrate surface topographical features serve at least in part to distribute said residual stress field through a larger volume of diamond and substrate materials than if said substrate surface topographical features were not present.

[cl052] 52. A bearing unit component as recited in claim 48 wherein said substrate surface topographical features serve at least in part to distribute residual stress in said polycrystalline diamond compact throughout the polycrystalline diamond compact structure in order to diminish stress per unit volume of structure compared to stress per unit volume in the polycrystalline diamond compact if said substrate surface modifications were not present.

[cl053] 53. A bearing unit component as recited in claim 42 wherein said mechanical grip is created by substrate dilatation during cooling after sintering the polycrystalline diamond compact.

[cl054] 54. A bearing unit component as recited in claim 39 wherein said substrate surface topographical features are selected from the group consisting of protruding and indented features.

[cl055] 55. A bearing unit component as recited in claim 39 wherein said substrate surface topographical features serve at least in part to interlock said diamond table and said substrate.

[cl056] 56. A bearing unit component as recited in claim 39 wherein said substrate surface topographical features serve at least in part to redistribute forces applied to the bearing unit in order to mitigate crack formation, cleavage, and crack propagation in said diamond table.

[cl057] 57. A bearing unit component as recited in claim 39 wherein said substrate surface topographical features are selected from the group consisting of waves, straight grooves, curved grooves, straight ridges, curved ridges, dimples, holes, protrusions, depressions, spherical segment depressions, spherical segment protrusions, hemispherical concave cups, hemispherical convex protrusions, partially spherical convex shapes, lines, curved lines, polygonal depressions, polygonal protrusions, cylindrical depressions, cylindrical protrusions, frusto-conical depressions, frusto-conical protrusions, waffle iron patterns and waffle patterns.